CLAIMS

What is claimed is:

1. A radar device including:

an antenna for radiating beams in a plurality of directions and for receiving as reception waves the beams having been reflected by targets;

a receiver for performing detection processing on the reception waves received by the antenna, to output received signals;

a signal detector for extracting from the received signals outputted by the receiver quantities characterizing the reception waves; and

a direction calculating unit for calculating a primary direction, being the direction of a target, from a combination of the characterizing quantities calculated by the signal detector based on the reception waves from at least two beams that partially overlap, among the beams radiated in the plurality of directions; the radar device characterized by

a direction integrating unit for, when a plurality of primary directions calculated by the direction calculating unit is present, calculating an integrated direction, being the true target direction, from an area in which the density in a distribution of the plurality of primary directions is a predetermined value or greater, the integrated direction calculation being based on the primary directions belonging to the area.

2. A radar device including:

an antenna for radiating beams in a plurality of directions and for receiving as reception waves the beams having been reflected by targets;

a receiver for performing detection processing on the reception waves received by the antenna, to output received signals;

a signal detector for extracting from the received signals outputted by the receiver quantities characterizing the reception waves; and

a direction calculating unit for calculating a primary direction, being the direction of a target, from a combination of the characterizing quantities calculated by the signal detector based on the reception waves from at least two beams that partially overlap, among the beams radiated in the plurality of directions; the radar device characterized by

a direction integrating unit for, when a plurality of primary directions calculated by the direction calculating unit is present, calculating an integrated direction, which is the true target direction, from an area in which the density in a distribution of the reception-wave characterizing quantities used in calculating the plurality of primary directions is a predetermined value or greater, the integrated direction calculation being based on the target directions belonging to the area.

3. A radar device according to claim 1 or 2, wherein the direction integrating unit forms a cluster from the primary directions belonging to the area in which the density is a predetermined value or greater, and calculates the integrated direction in units of that cluster.

4. A radar device according to claim 3, wherein, when the angular difference between two of the primary directions is a predetermined value or greater, the direction integrating unit assigns the two target directions

to different clusters.

5. A radar device according to claim 3, wherein the direction integrating unit obtains a distribution center of a plurality of primary directions belonging to the cluster, and outputs the distribution center as the integrated direction of the cluster.

6. A radar device according to claim 5, wherein the direction integrating unit obtains the distribution center based on angles of the primary directions belonging to the cluster, each weighted by the reception-wave characterizing quantity used in calculating the primary direction.

7. A radar device according to claim 6, wherein the direction integrating unit performs weighting by using the reception amplitude of the reception wave as the reception-wave characterizing quantity.

8. A radar device according to claim 6, wherein the direction integrating unit performs weighting by using the reception power of the reception wave as the reception-wave characterizing quantity.

9. A radar device according to claim 3, wherein the direction integrating unit designates as the integrated direction of the cluster the target direction where the reception-wave reception amplitude used in calculating the primary direction belonging to the cluster is maximum.

10. A radar device according to claim 3, wherein the direction integrating unit designates as the integrated direction of the cluster the primary direction where the reception-wave reception power used in calculating the primary direction belonging to the cluster is maximum.

11. A radar device according to claim 2, wherein the direction integrating unit obtains the density in a distribution of the reception-wave reception amplitude used in calculating the primary direction, and outputs as the integrated direction the angle where the distribution density is locally maximum.

12. A radar device according to claim 11, wherein the direction integrating unit obtains the distribution density by setting a window function for smoothing the reception-wave reception amplitude.

13. A radar device according to claim 1, wherein the direction integrating unit obtains strength of the integrated direction, and outputs the integrated direction if the strength satisfies a predetermined condition.

14. A radar device according to claim 13, wherein the direction integrating unit obtains as the strength of the integrated direction the total sum of the reception-wave reception amplitudes used in calculating the integrated direction.

15. A radar device according to claim 13, wherein the direction integrating

unit obtains as the strength of the integrated direction the mean value of the reception-wave reception amplitudes used in calculating the integrated direction.

16. A radar device according to claim 13, wherein the direction integrating unit obtains as the strength of the integrated direction the mean value of the reception-wave reception powers used in calculating the integrated direction.

17. A radar device according to claim 13, wherein, if the strength of the integrated direction is a predetermined value or greater, the direction integrating unit outputs the integrated direction.

18. A radar device according to claim 3, wherein the direction integrating unit obtains, based on the number of the primary directions belonging to the cluster, strength of the integrated direction of the cluster, and outputs the integrated direction if the strength satisfies a predetermined condition.

19. A radar device according to claim 3, wherein the direction integrating unit selects a predetermined number of the integrated directions in descending order of the strength, and outputs the selected integrated directions.

20. A radar device according to claim 3, wherein the direction integrating unit estimates, assigning the calculated integrated direction to an initial

value of an angle component, the target directions by performing model fitting on model reception signals that are preset assuming the angle and reflectance ratio of the target, and the received signals used in calculating the primary direction by the direction calculating unit.

21. A radar device according to claim 20, wherein the direction integrating unit selects from the primary directions belonging to the cluster a predetermined number of primary directions, and performs the model fitting for estimating the reflectance ratio using a least-square method assuming one of the selected primary directions as the angle component.

22. A radar device according to claim 21, wherein, if the reflectance ratio estimated by the model fitting is a predetermined value or greater, the direction integrating unit estimates the target direction with respect to the cluster.

23. A radar device according to claim 21, wherein the direction integrating unit rejects an integrated direction calculated from the cluster where the minimum value of a residual sum of squares in the model fitting is a predetermined value or greater.